Geothermal/Ground-Source Heat Pump Application Opportunities Under the MCP

MassDEP/LSPA Training Course

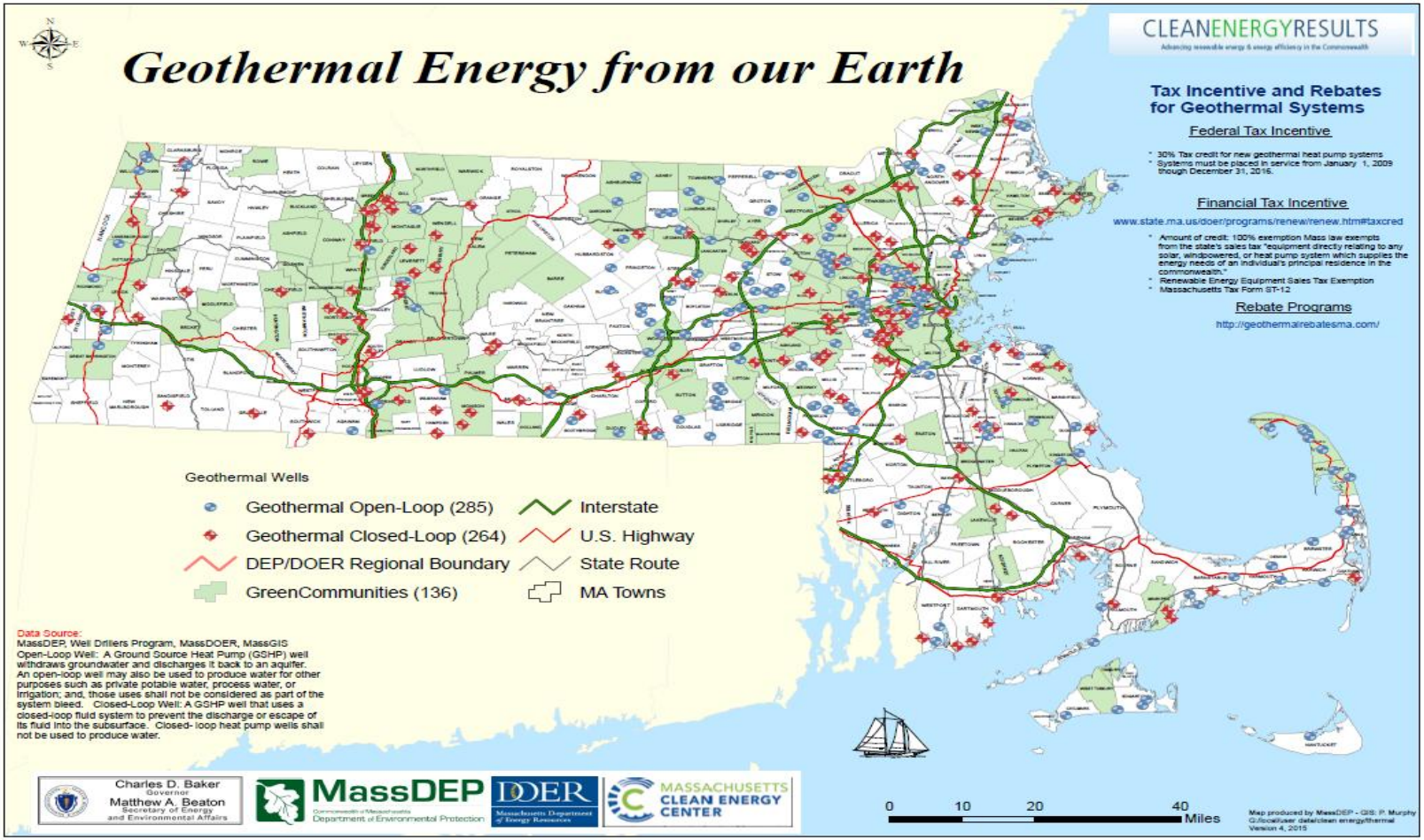
Tuesday, May 5th — Westborough, MA

Thursday, May 7th — Taunton, MA

Thomas M. Potter, Clean Energy Development Coordinator

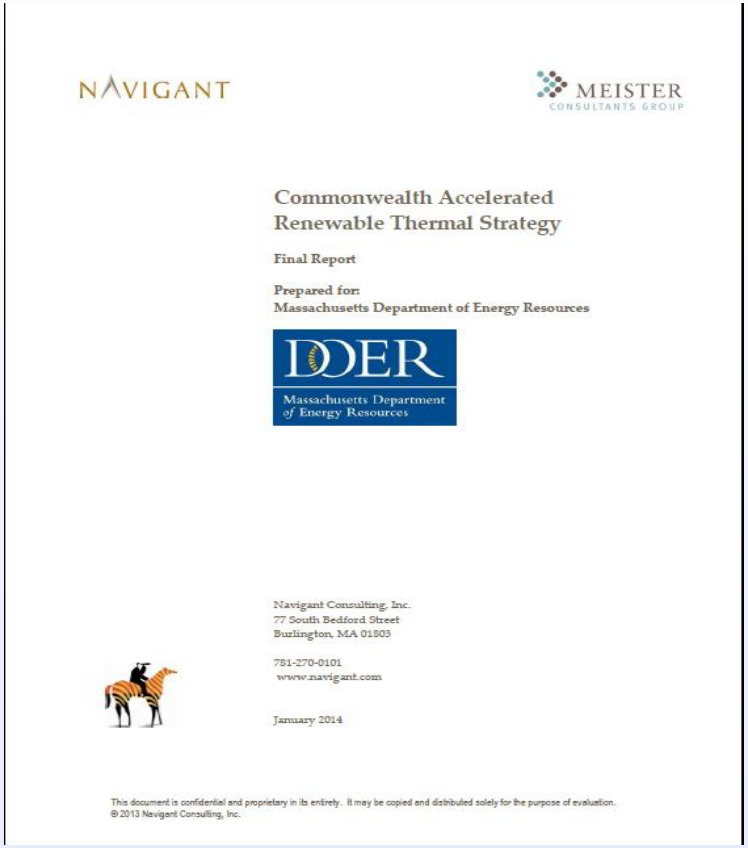
Geothermal In Massachusetts

(Open Loop 285 | Closed Loop 264)



OPPORTUNITY:
Commonwealth Accelerated Renewable Thermal Strategy (CARTS)

- **January 2014 Study**
- **Objectives:**
  - Reduce GHG emissions
  - Expand economic development opportunities
  - Reduce heating and cooling costs for consumers
- **Main Opportunities:**
  - Efficient Heat Pumps (air/ground) in residential applications
  - Clean biomass (pellets/chips) in commercial buildings


NAVIGANT

MEISTER CONSULTANTS GROUP

Commonwealth Accelerated Renewable Thermal Strategy

Final Report

Prepared for:
Massachusetts Department of Energy Resources

DOER
Massachusetts Department of Energy Resources

Navigant Consulting, Inc.
77 South Bedford Street
Burlington, MA 01803

781-270-0101
www.navigant.com

January 2014

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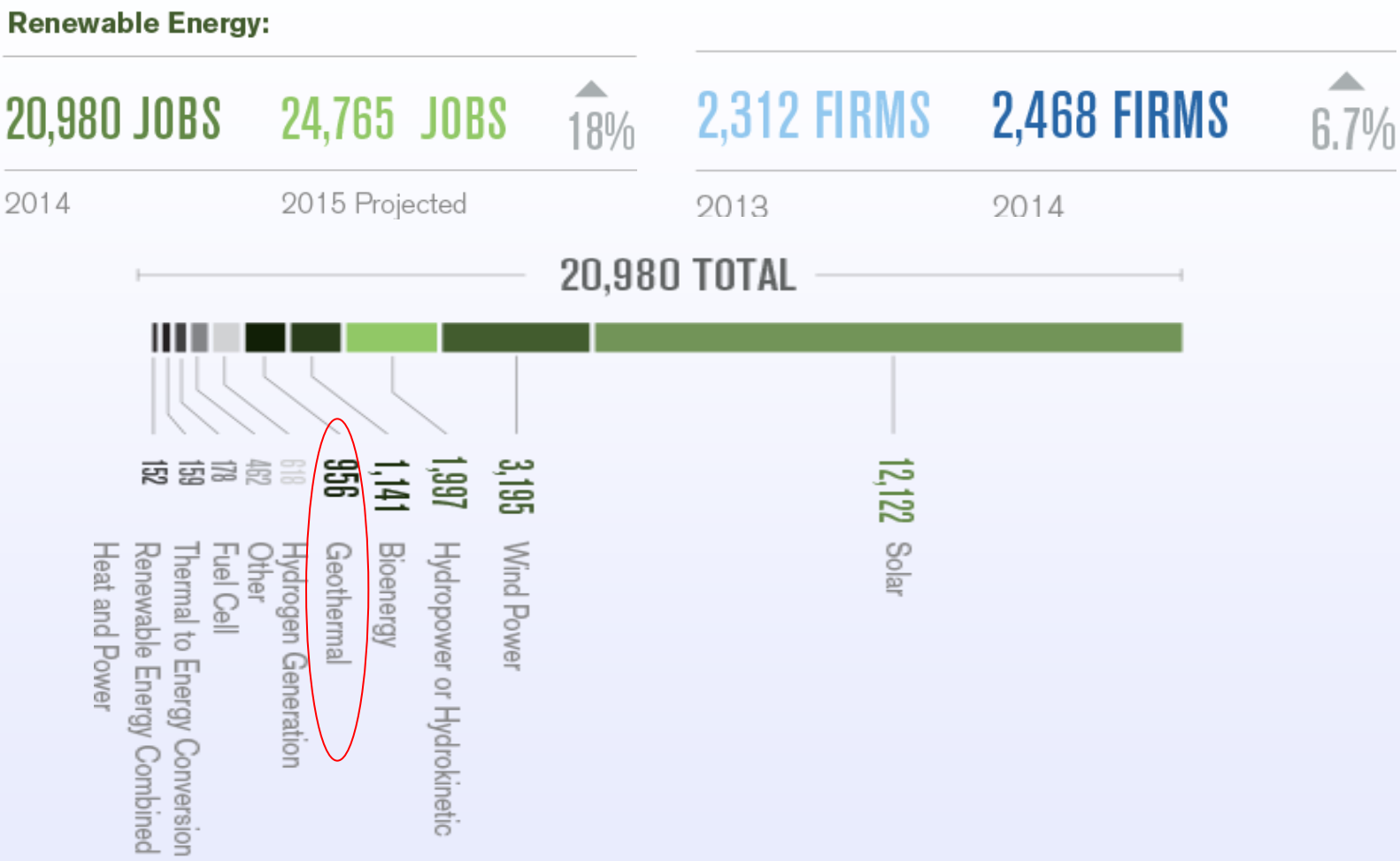
CARTS (cont.)

Market:

- Commercial, Large Buildings, Using Fuel Oil / Electricity
- Residential, High Income, Using Fuel Oil
- Residential, Low Income, Using Fuel Oil / Electric
- "Priority customers will likely be living in areas not served by natural gas utilities, outside of gas service areas, or a long distance from gas distribution. Currently about 1.2 million households in Massachusetts are not using natural gas for space heating"

2014 Renewable Energy Jobs



Why Licensed Site Professionals?

LSP's have the professional credentials that align with GSHP applications

- Geologists
- Hydrogeologists
- Engineers
- Environmental Scientists

AGENDA

1. Renewable Thermal Technologies & Greener Cleanups Nexus

2. MCP Considerations for Ground-Source Heat Pump Applications to:

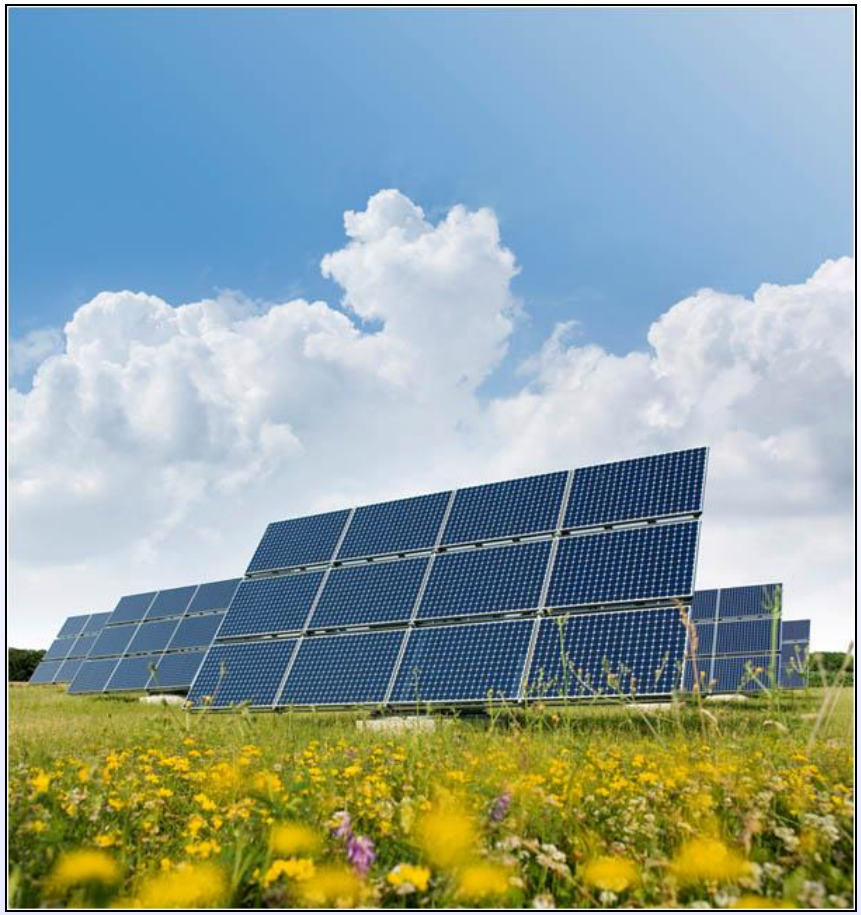
    a. Site Redevelopment
    b. Remedial Response
    c. Remedy Repurposing

Massachusetts Clean Energy Efforts

- 2007 established **Executive Office of Energy & Environmental Affairs**
- 2008 **Green Communities Act (GCA)**
  - Supports Development of Clean Energy Resources
  - Expands Efforts to Promote Energy Efficiency
  - Increased the Renewable Energy Portfolio Standard (RPS) to 1% per year.
  - **Goal of 15% "New Sources" by 2020 (currently 9%)**
- 2008 **Global Warming Solutions Act**
  - Comprehensive Program -> Climate Change
  - Goal 25 % Below 1990 GHG levels by 2020

CLEANENERGYRESULTS

- Launched 2011
- **Promotes Clean and Efficient Sources of Energy at MassDEP Regulated Sites (where we have authority or control)**
- Maximizes MassDEP's Unique Expertise to Overcome Permitting & Siting Obstacles
- **Create economic growth and employment opportunities**



CLEANENERGYRESULTS

RPS/APS Projects including:

- Solar Photovoltaic
- Wind
- Anaerobic Digestion
- Renewable Thermal Technologies
  - Solar space & domestic hot water heating
  - Biomass pellets 7 chips
  - Heat Pumps (ground, water, air)
  - Biogas (renewable gas)
  - Advanced biofuels

CLEANENERGYRESULTS

- *"Promote the use of Green Remediation/Greener Cleanups at state and federally regulated contaminated sites"*

- *Promote use of Renewable Thermal Technologies - specifically Ground-Source Heat Pumps*

310 CMR 40.0191
Response Action Performance Standard (RAPs)

- (3) The application of RAPS shall be protective of health, safety, public welfare and the environment and shall include, without limitation, in the context of meeting the requirements of this Contingency Plan, consideration of the following:
  - *(e) eliminating or reducing, to the extent practicable and consistent with response action requirements and objectives, total energy use, air pollutant emissions, greenhouse gases, water use, materials consumption, and ecosystem and water resources impacts resulting from the performance of response actions through energy efficiency, renewable energy use, materials management, waste reduction, land management, and ecosystem protection.*

Greener Cleanups Guidance (WSC #14 – 150)

- DRAFT
  - May 2014
- COMMENTS
  - July 2014
- FINAL EFFECTIVE
  - October 2014

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
Department of Environmental Protection
One Winter Street Boston, MA 02108 • 617-292-5500

DEVAL L. PATRICK
Governor

RICHARD K. SULLIVAN JR.
Secretary

DAVID W. CASH
Commissioner

GREENER CLEANUPS GUIDANCE
WSC #14 – 150

This document provides guidance in support of 310 CMR 40.0191 and 310 CMR 40.0858 on recommended approaches that maximize the net environmental benefit when conducting response actions at disposal sites regulated under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000. Recommended approaches include adherence to available industry standards and guidance as described further in this document.

This document is intended solely as guidance. It is not a regulation, rule or requirement, and should not be construed as mandatory. It does not create any substantive or procedural rights, and is not enforceable by any party in any administrative proceeding with the Commonwealth. This document provides guidance on approaches MassDEP considers acceptable for meeting the general requirements set forth in the MCP. Parties using this guidance should be aware that other acceptable alternatives may be available for achieving and documenting compliance with the applicable regulatory requirements and performance standards of the MCP.

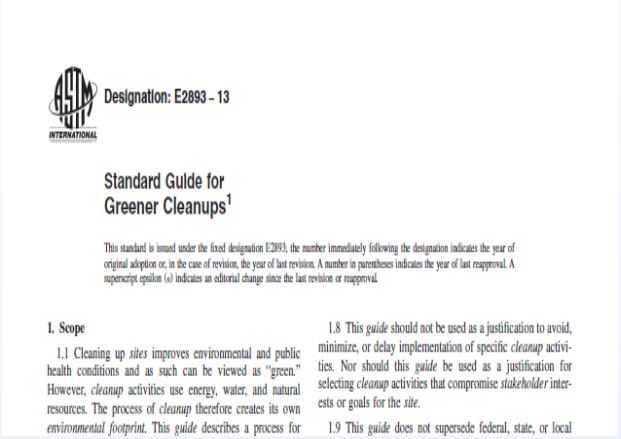
Benjamin J. Ericson
Assistant Commissioner
Bureau of Waste Site Cleanup

October 20, 2014

This information is available in alternate format. Call Michelle Waters-Ekanem, Diversity Director, at 617-292-5751. TDD# 1-866-539-7622 or 1-617-574-6868
MassDEP Website: www.mass.gov/dep
Printed on Recycled Paper

MassDEP Recommendation

MassDEP strongly recommends use of the *ASTM Standard Guide for Greener Cleanups* ("the ASTM Guide") (Designation: ASTM E2893-13, November 2013)



Designation: E2893 – 13

Standard Guide for Greener Cleanups[1]

This standard is issued under the fixed designation E2893; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 Cleaning up *sites* improves environmental and public health conditions and as such can be viewed as "green." However, *cleanup* activities use energy, water, and natural resources. The process of *cleanup* therefore creates its own *environmental footprint*. This *guide* describes a process for

1.8 This *guide* should not be used as a justification to avoid, minimize, or delay implementation of specific *cleanup* activities. Nor should this *guide* be used as a justification for selecting *cleanup* activities that compromise *stakeholder* interests or goals for the *site*.

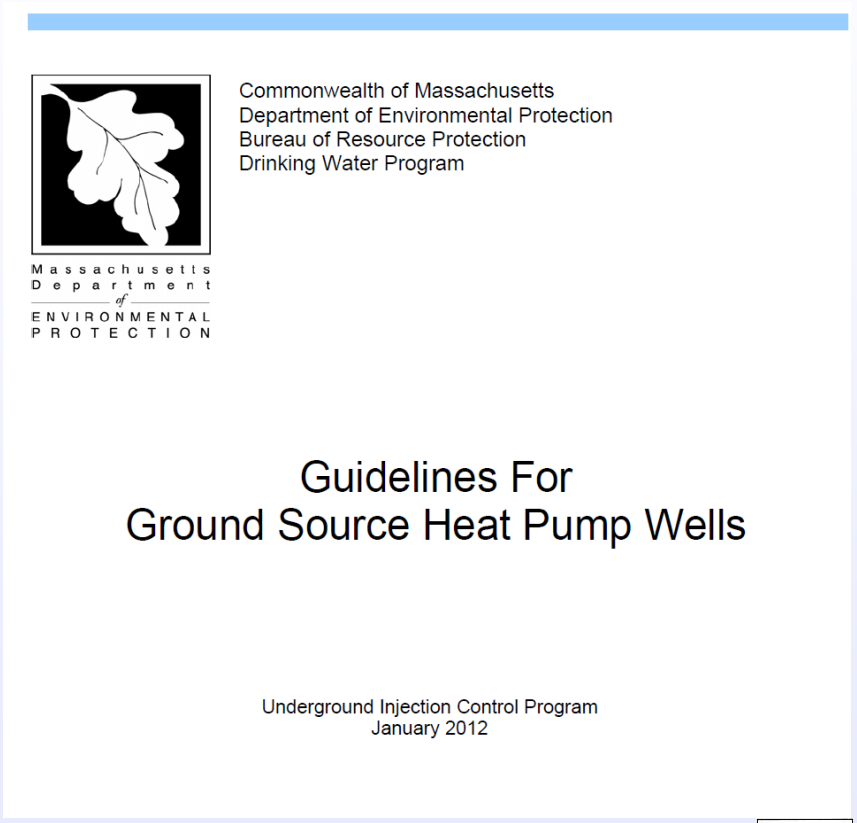
1.9 This *guide* does not supersede federal, state, or local

Compliance Through Available Industry Standards & Guidance

- **USEPA, CLU-IN**, Green Remediation Focus (http://cluin.org/greenremediation/)
- **ASTM** International, November 2013, *Standard Guide for Greener Cleanups*, E2893-13
- **ITRC**, November 2011, *Technical/Regulatory Guidance, Green and Sustainable Remediation: A Practical Framework* (GSR-2).

Guidelines For
Ground Source Heat Pump Wells

- MassDEP Bureau of Water Resources (BWR) regulates GSHP installations
- BWSC working with BWR on contaminated site applications



SITE REDEVELOPMENT

MCP Regulatory Considerations

GSHP Opportunities

Former Brownfield ...

Sustainable Property Development (e.g. LEED)

Massachusetts Department of ENVIRONMENTAL PROTECTION

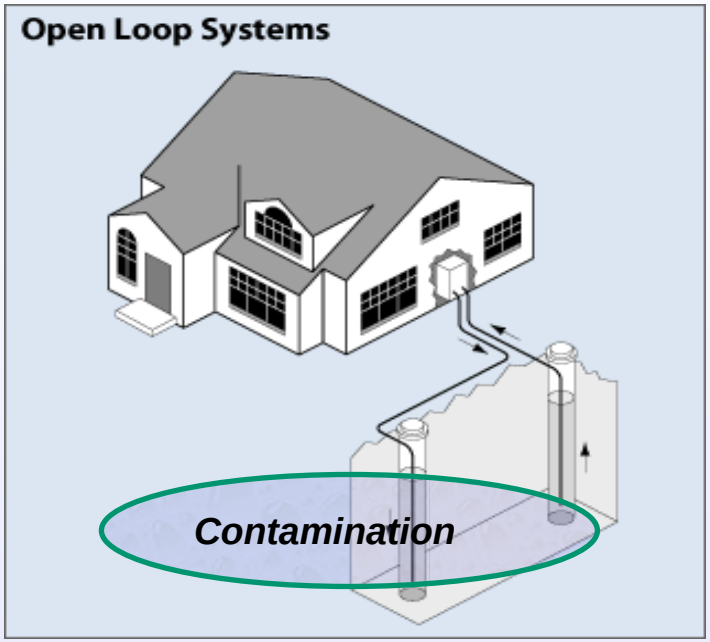
Prior to GSHP Installation

- History
- Environmental Condition
- Groundwater quality
  - Open Loop vs.
  - Closed Loop

If the Site is "OPEN" or Not a Reported Site
(Preliminary/Comprehensive Response Actions)

OPEN Loop Systems

- For UIC Registration of open loop systems, groundwater conditions must not exceed one or more Maximum Contaminant Level (MCL) drinking water limits as prescribed by the Bureau of Water Resources, and/or
- If groundwater conditions also exceed RCGW-1 per 310 CMR 40.0300 (you must report)
- Open Loop system may only proceed on a case by case basis with exempt conditions

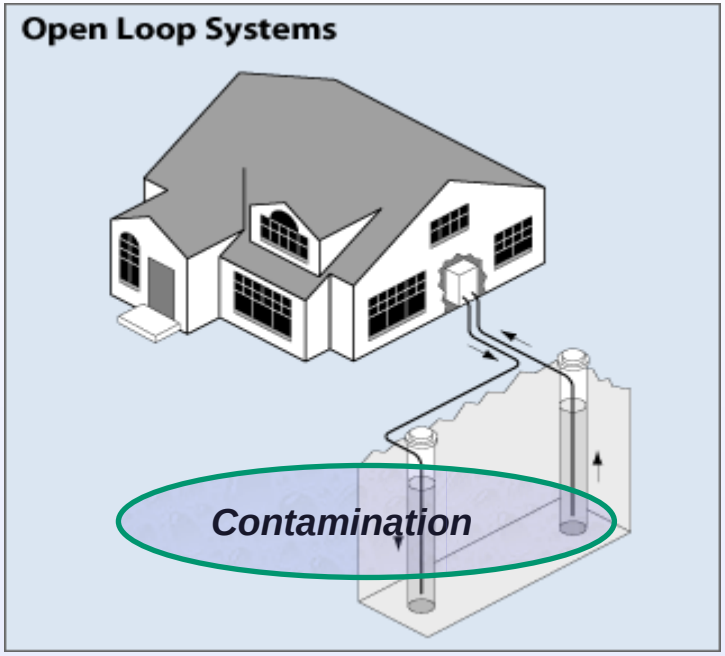


Exempt Conditions

Release Exemptions per 310 CMR 40.0317:

(20) releases of chloroform in groundwater attributable to naturally-occurring ecological processes . . .

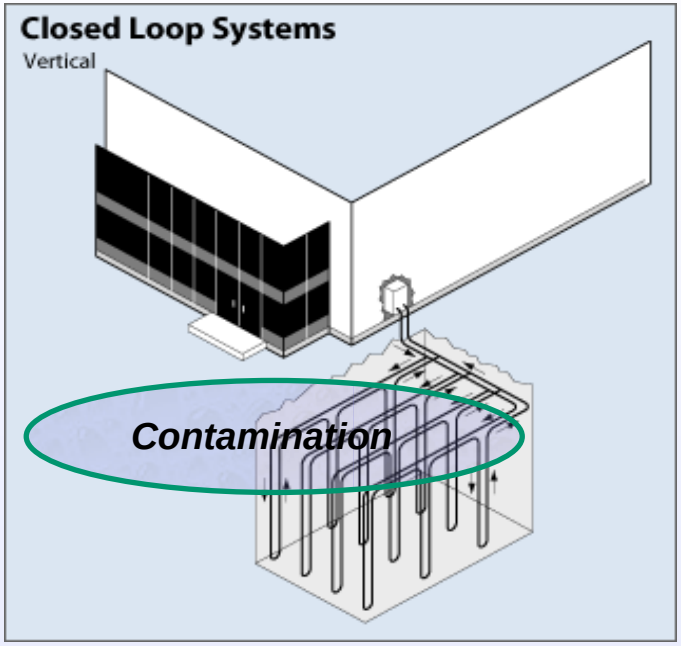
(22) arsenic, beryllium or nickel in Boston Blue Clay or arsenic in an area documented by the U.S. Geological Survey or in other scientific literature as an area of elevated arsenic measured in soil or groundwater . . .



If the Site is "OPEN" or Not a Reported Site
(Preliminary/Comprehensive Response Actions)

CLOSED Loop Systems

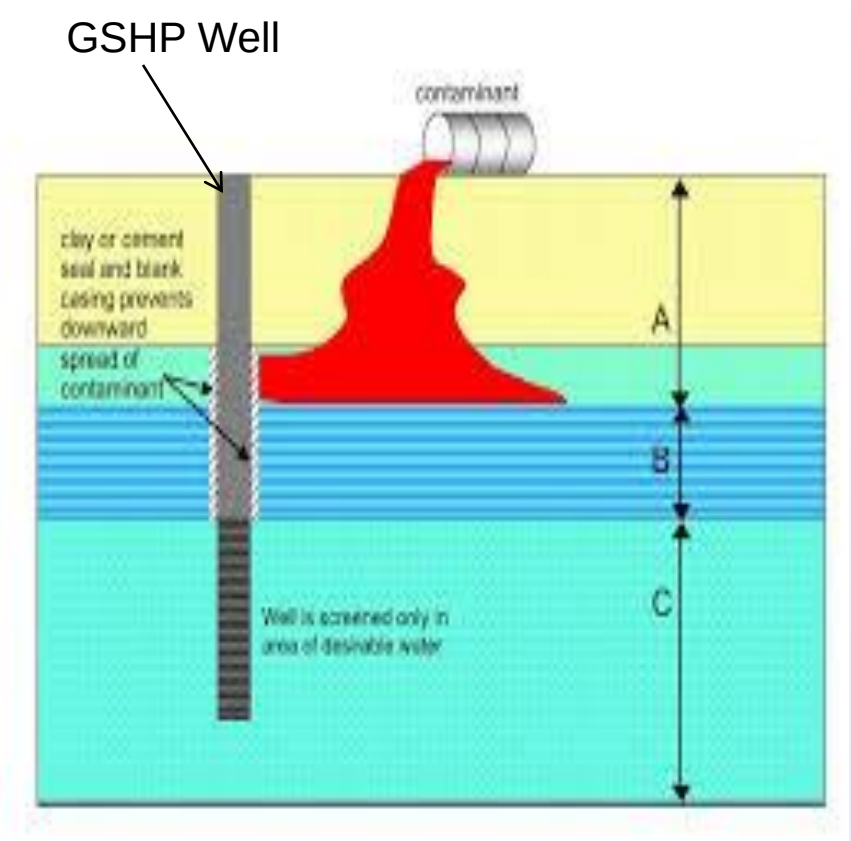
- Option when . . .
- Contamination is present above MCLs, is reportable through the MCP
- For UIC Registration – need a statement that GSHP installation will not exacerbate the contamination



Contamination Exacerbation

- Well installations and operations must ensure the prevention of vertical migration of contamination

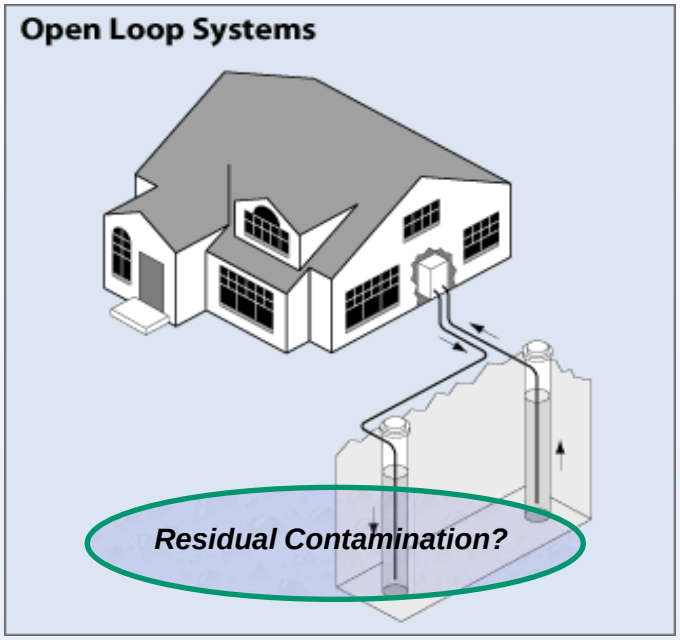
- All excavated soils must be handled in accordance with 310 CMR 40.0030



If the Site is "CLOSED"
(Permanent Solution/Permanent Solution with Conditions)

OPEN Loop Systems

- Consider baseline water quality conditions
- Open loop system not applicable at or above MCLs (with exemptions)



If the Site is "CLOSED"
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CLOSED Loop Systems

- Consider baseline water quality conditions
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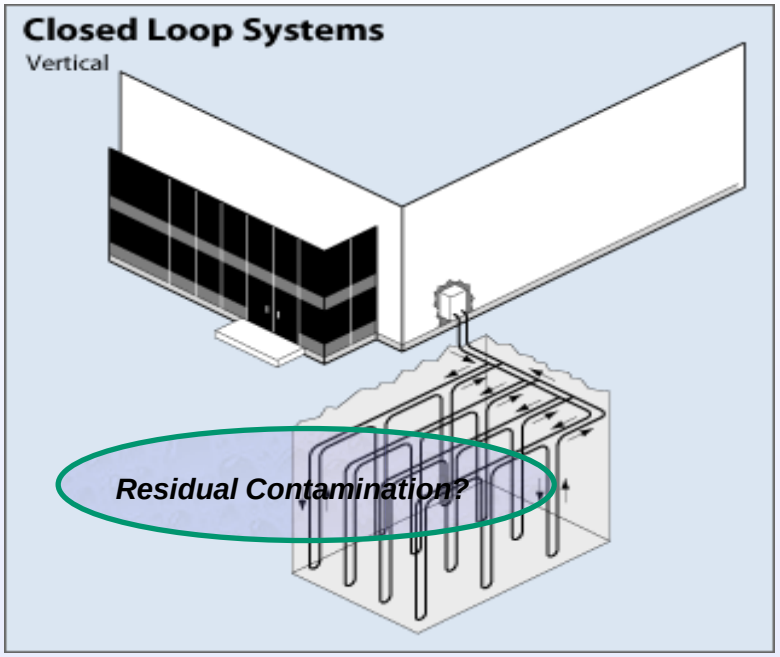
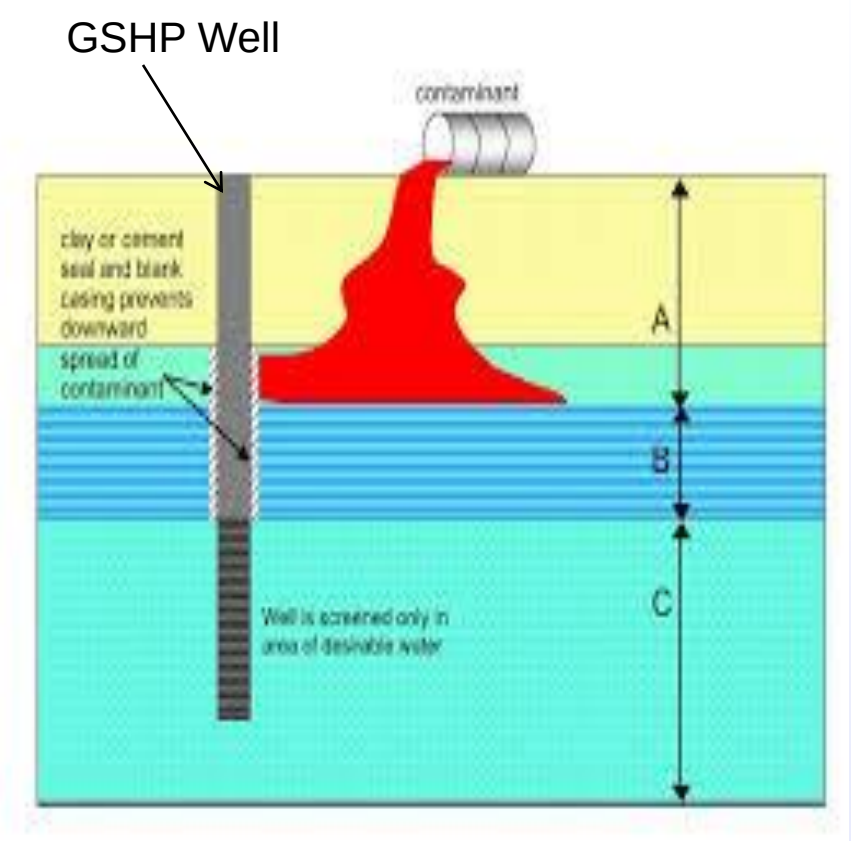


Contamination Exacerbation

- Well installations and operations must ensure the prevention of vertical migration of contamination
- All excavated soils must be handled in accordance with 310 CMR 40.0030
- Must adhere to any AUL conditions



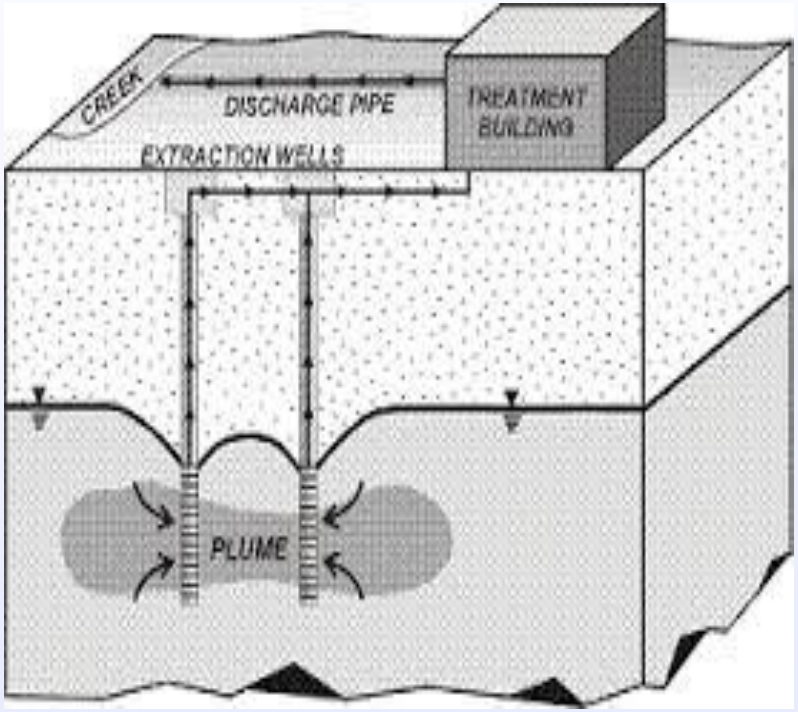
REMEDIAL RESPONSE(S)

MCP Regulatory Considerations

GSHP Opportunities

Field Excavations/Remedy Installations

Groundwater Recovery & Treatment Systems (a.k.a. P&T)

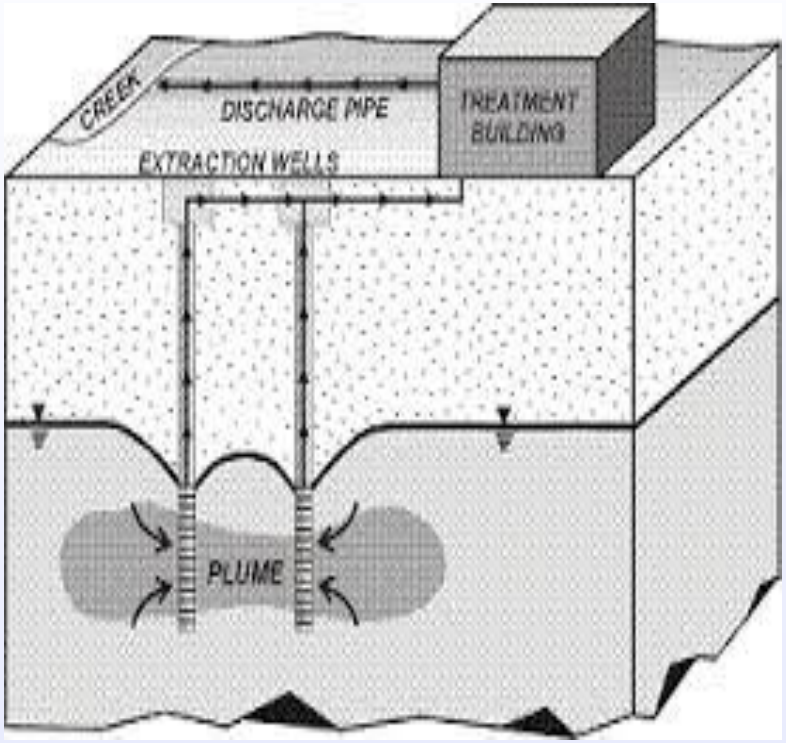


Field Excavations/Remedy Installations

- Remedial activities that include soil excavation provide opportunities for GSHP installations
  - LUST
  - Source Area Removal
  - Etc.

Groundwater Recovery & Treatment Systems (a.k.a. Pump & Treat)

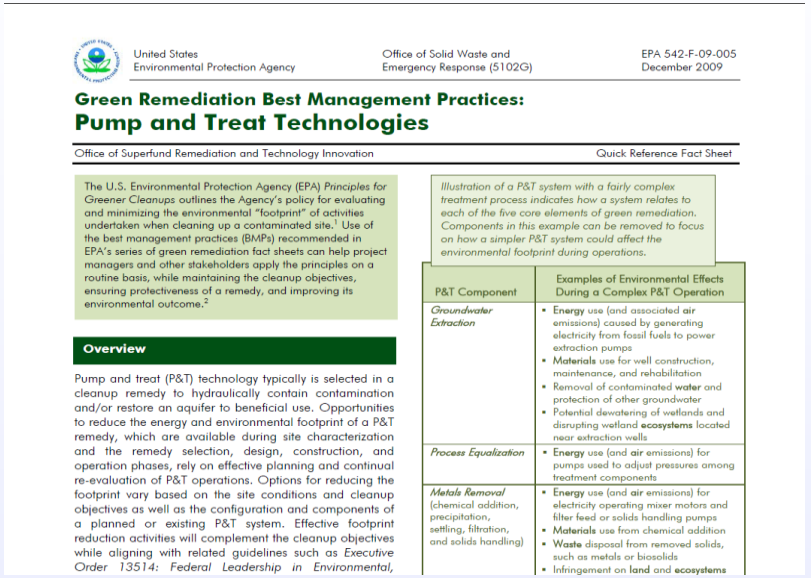
- ~ 140 P&T Systems installed in MA
- The remedial selection and/or existing operation of P&T systems provides opportunities for GSHP installations



Best Management Practices (BMP's): Pump & Treat Technologies

Ground Source Heat Pump Greener Cleanup Applications/Opportunities:

- Use of GSHP generated heat for the treatment processes
- Use of GSHP to provide space heating and cooling for treatment system housing and/or nearby buildings
- Re-evaluating the potential for renewable energy application at long-term remedies as new technologies and incentives become available such as GSHP's



United States Environmental Protection Agency | Office of Solid Waste and Emergency Response (5102G) | EPA 542-F-09-005 December 2009

Green Remediation Best Management Practices: Pump and Treat Technologies

Office of Superfund Remediation and Technology Innovation | Quick Reference Fact Sheet

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outlines the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) recommended in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis, while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.[2]

Illustration of a P&T system with a fairly complex treatment process indicates how a system relates to each of the five core elements of green remediation. Components in this example can be removed to focus on how a simpler P&T system could affect the environmental footprint during operations.

P&T Component	Examples of Environmental Effects During a Complex P&T Operation
Groundwater Extraction	• **Energy** use (and associated **air** emissions) caused by generating electricity from fossil fuels to power extraction pumps • **Materials** use for well construction, maintenance, and rehabilitation • Removal of contaminated **water** and protection of other groundwater • Potential dewatering of wetlands and disrupting wetland **ecosystems** located near extraction wells
Process Equalization	• **Energy** use (and **air** emissions) for pumps used to adjust pressures among treatment components
Metals Removal (chemical addition, precipitation, settling, filtration, and solids handling)	• **Energy** use (and **air** emissions) for electricity operating mixer motors and filter feed or solids handling pumps • **Materials** use from chemical addition • **Waste** disposal from removed solids, such as metals or biosolids • Infringement on **land** and **ecosystems**

Overview

Pump and treat (P&T) technology typically is selected in a cleanup remedy to hydraulically contain contamination and/or restore an aquifer to beneficial use. Opportunities to reduce the energy and environmental footprint of a P&T remedy, which are available during site characterization and the remedy selection, design, construction, and operation phases, rely on effective planning and continual re-evaluation of P&T operations. Options for reducing the footprint vary based on the site conditions and cleanup objectives as well as the configuration and components of a planned or existing P&T system. Effective footprint reduction activities will complement the cleanup objectives while aligning with related guidelines such as *Executive Order 13514: Federal Leadership in Environmental,*

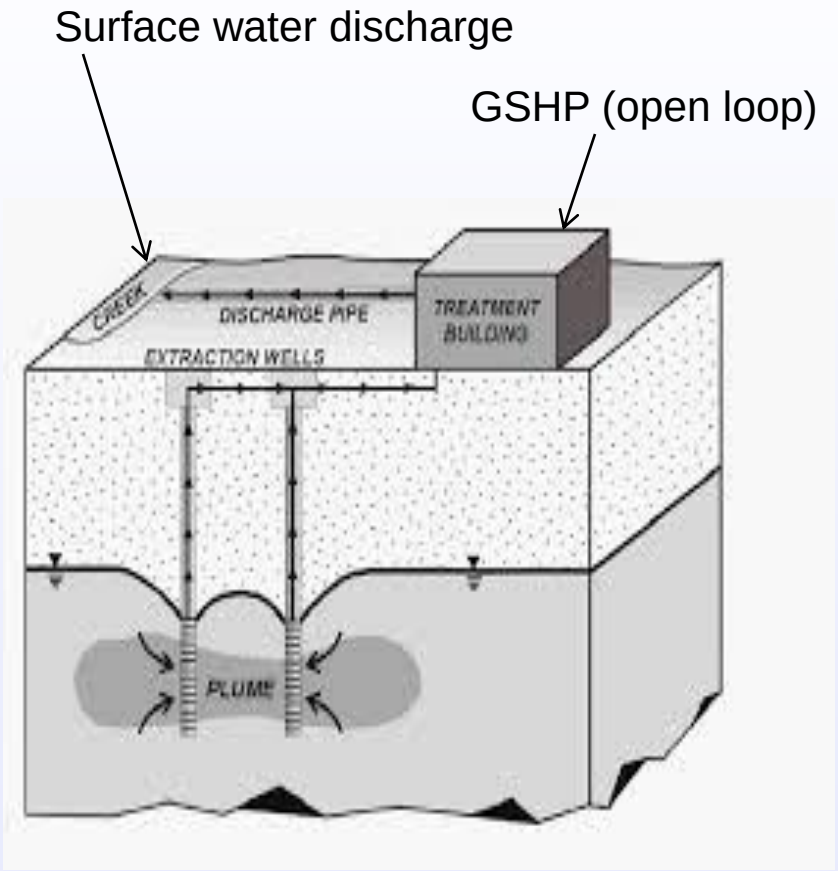
http://www.clu-in.org/greenremediation/docs/GR_Fact_Sheet_P&T_12-31-2009.pdf

Renewable Thermal/Geothermal
Best Management Practices (BMP's)

			Core Element Addressed			Remediation Technology		
		Best Management Practice	Energy	Air	Water	Soil Vapor Extraction	Air Sparging	Pump and Treat
9	Buildings	** Use non "natural conditions" methods for energy conservation (for example, choosing Energy Star qualified boilers or heat pumps) . . . for energy efficient heating and cooling into new buildings . . (follows #8)	X			X	X	X
49	Power and Fuel	Capture on-site waste heat such as treatment plant effluent, excess plant steam, ground-source heat pumps, mobile waste-to-heat generators, and furnaces/air conditioners operating with recycled oil to power cleanup activities. For example, integrate a CHP system powered by natural gas or cleaner diesel to generate electricity while capturing waste heat to be used to condition air inside buildings, for vapor treatment, or for other onsite operations	X	X		X	X	X
62	Power and Fuel	** Use heat pumps or solar heating in place of electrical resistive heating when preheated extracted groundwater is required prior to treatment	X					X

Remedial System Discharge

- P&T systems utilize "open loop" GSHP systems that discharge to:
  - Surface Waters
  - POTWs
  - Groundwater



Remedial System Discharge (cont.)

MCP "control"

- UIC Registration is not necessary for a GSHP that's are operating as part of an MCP response action conducted under the direction of a LSP

- UIC Registration is required once MCP remedial Response Actions end

MCP Discharge Considerations

- **Surface Water** (310 CMR 40.0042)
- **POTW** (310 CMR 40.0043 & 40.0044)
- **Groundwater** (310 CMR 40.0045)
  - Downgradient, 40.0045(3)
  - Upgradient, 40.0045(4)

Additional GSHP Opportunity Considerations

- Is there a nearby building/facility with heating cooling needs?
- Could the open loop P&T system provide a benefit?
- Is it cost effective?

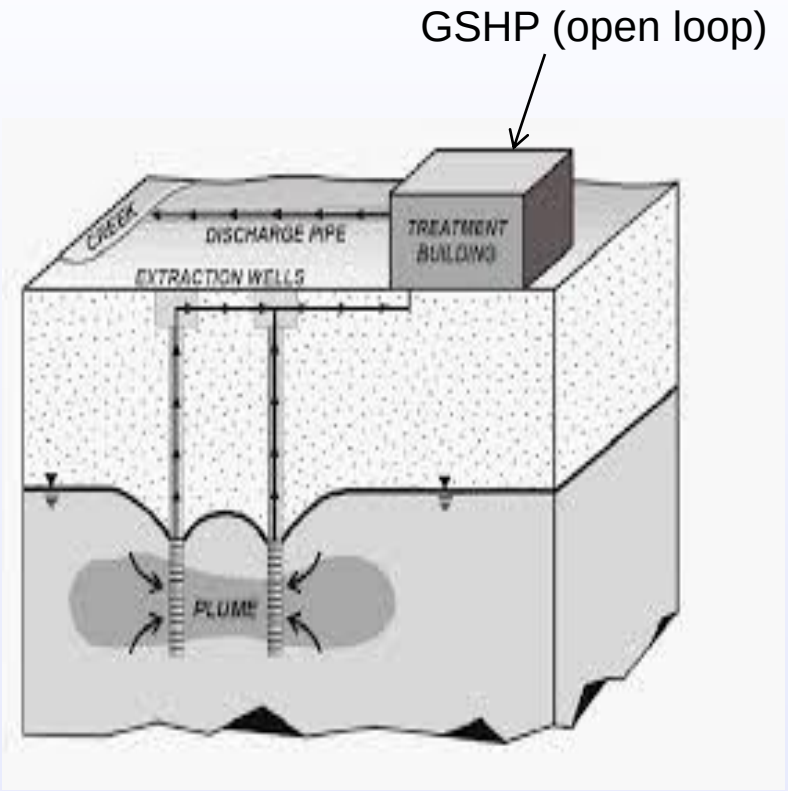
REMEDY REPURPOSING

MCP Regulatory Considerations

Repurposing Former P&T Systems

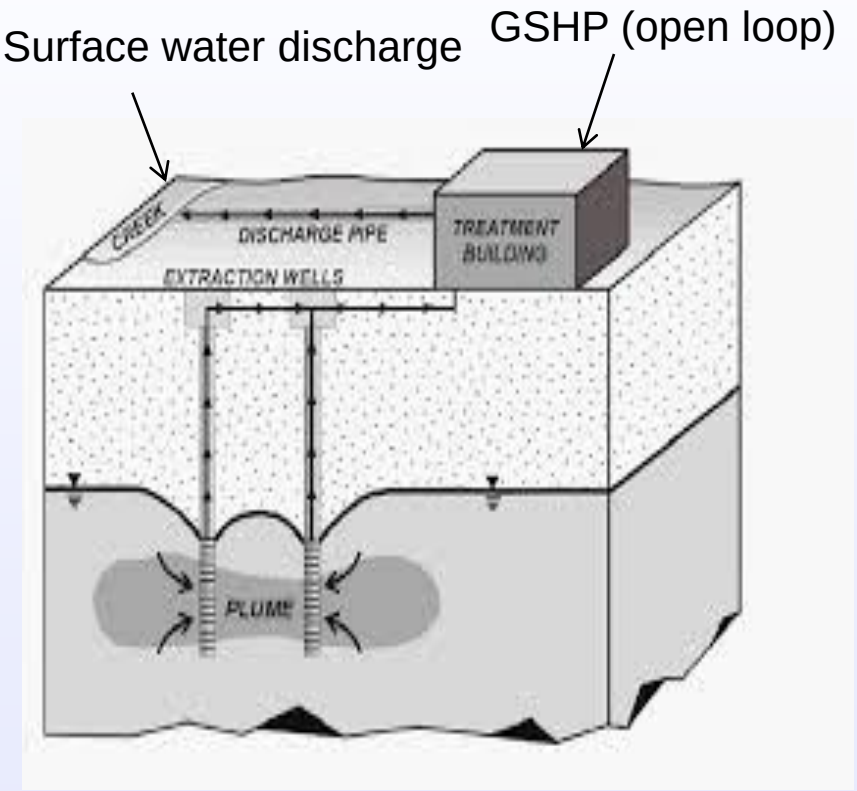
- Consider GSHP Benefit
  - Nearby heating load?

- Existing infrastructure
  - Standing column groundwater extraction wells
  - Extraction Pumps
  - Piping, flow meters and valves
  - Treatment system housing
  - Dedicated electrical meter



Repurposing Former P&T Systems (cont.)

- Groundwater quality?
  - Would treatment be necessary? (e.g. above MCLs)
- Regulatory Authority?
  - The system would no longer be operating as a remedial remedy under the MCP
  - Any associated “open loop” GSHP would be regulated by BWR’s UIC program and would require UIC registration



COMING SOON!

FACT SHEET: *"RENEWABLE THERMAL TECHNOLOGY APPLICATIONS AT CONTAMINATED PROPERTIES IN MASSACHUSETTS: GROUND-SOURCE HEAT PUMPS"*

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http://www.mass.gov/eea/agencies/massdep/cleanup/reports/site-cleanup-news-and-updates.html

Thank You!

Thomas M. Potter

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Clean Energy Results Program Website:

http://www.mass.gov/eea/agencies/massdep/climate-energy/energy/